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ABSTRACT

Research compared Mexico's television-based Telesecundaria (TS) with its more traditional secondary school counterpart, the Ensenanza Directa (ED). The data collected indicated that the TS schools tended to be located in poorer rural communities and to have larger classes and less adequate facilities; its students were generally older and from poorer less-educated families, and its teachers were not as well trained as those in the ED system. Despite these disadvantages, however, the TS system's output, as measured by student achievement in math, Spanish, and chemistry, was greater than that of the ED. Since the cost of the TS was at least 25% lower than the cost of the ED, it was concluded that the TS more effectively met Mexico's secondary education needs. This was deemed particularly significant in light of the fact that due to budget limitations, the ED system was able to serve only 65% of the primary graduates wishing to continue their education. It was therefore recommended that Mexico's educational policymakers seriously consider implementing the TS on a national scale. (PB)

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EXTENDING THE SCHOOL WITH TELEVISION: THE CASE OF MEXICO'S TELESECUNDARIA

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Characteristics of Mexico's Telesecundaria System

Faced with a large school age population and a concomitant increase in educational demand at all levels, the Mexican government has turned to educational technology, principally radio and television, to supplement the services of and alleviate the pressures on its traditional school system. The Telesecundaria is the largest and most important undertaking of this kind. It uses television to provide a full, three year secondary education to students who, for a wide variety of reasons, would not otherwise have access to schooling beyond the 6th grade.

In 1965, the number of primary school graduates unable to enter secondary school in Mexico surpassed 180,000, approximately 37 percent of the previous year's 6th graders. The lack of opportunity at the secondary level was most acute in the rural areas where the number of primary school graduates is still relatively small but where there have not been sufficient funds either to build new schools or to provide qualified teaching personnel. The vast majority of Mexico's rural communities (those with less than 2,000 inhabitants) produce fewer than thirty 6th grade graduates per year, and under such circumstances the government has not felt it economically feasible to provide the same kind of secondary schools found in larger Mexican towns and cities. For these reasons, the Telesecundaria system was inaugurated.

Telesecundaria began cautiously and on a small scale in September, 1966, with closed-circuit broadcasting to an experimental school in Mexico City. The following year, open broadcasting began

to 6,569 7th grade students in 304 classrooms scattered throughout seven states* and the Federal District. As Table I illustrates, the Telesecundaria expanded rapidly in its first three years. By 1970, it was serving approximately 3 percent of the entire Mexican secondary school population.

TABLE I

Student Enrollment in Telesecundaria

	1968	1969	1970	1971	1972
7th grade	6,569	10,916	11,175	14,499	12,432
8th grade		5,324	8,240	9,459	9,194
9th grade			5,473	6,997	7,350
Totals	6,569	16,240	25,888	30,955	28,976

Source: Secretariat of Public Education data

Unlike most other educational television systems which have been developed in the last decade, the Mexican Telesecundaria was designed to complement rather than reform or replace the traditional school. Its basic purpose was to extend secondary education to young people who had previously been denied such opportunity. Students enrolled in the Telesecundaria were given equal official status with those in the traditional system. They met the same requirements for admission and received the same accreditation.

While retaining the identical curriculum and goals of the traditional Mexican secondary school system, the Telesecundaria employs a mix of national and community resources. In place of large,

* Hidalgo, Mexico, Morelos, Oaxaca, Puebla, Tlaxcala and Veracruz.

federally financed school buildings, Telesecundaria classes customarily meet in space provided by the local communities. Such space consists of one, two, or three rooms (designated teleaulas) donated by the municipal government, local cooperatives or other social service agencies. Occasionally, space is given by a local patron or by one of the students' families. In communities where interest runs particularly high, parent organizations (patronatos) have been instrumental in raising money for the construction and maintenance of permanent facilities.

Instead of fully-accredited and specialized secondary school teachers, the Telesecundaria relies upon classroom coordinators (maestros coordinadores) to oversee all instruction. The coordinators are drawn from the ranks of 5th and 6th grade primary school teachers and are paid by the federal government. Unlike their counterparts in the traditional system who must specialize in one or two subjects, Telesecundaria coordinators are assigned to one class of students whom they instruct in the whole range of 7th, 8th or 9th grade subjects. The coordinators are provided some special training in the use of television and are supplied with a monthly outline and schedule of the topics to be covered in each telelesson. Workbooks to assist students in the daily utilization of teleclasses are distributed at low cost through commercial bookstores.

In a typical week, students receive thirty televised lessons divided among various academic subjects and vocational activities. Teleclasses average twenty minutes in length with the remaining forty minutes of each class divided equally between preparation and follow-

up activities supervised by the classroom coordinators. Teleclasses are broadcast Monday through Friday, with Saturday morning being reserved for broadcasts to the classroom coordinators. To accommodate a very tight broadcast schedule, transmissions to the three secondary grades are staggered so that a twenty minute lesson to the 7th grade is followed immediately by one to the 8th grade, and finally by one to the 9th grade.

Production activities of the Telesecundaria are centered in four studios maintained by the federal government in Mexico City. The lessons are transmitted over XHGC-TV, Channel 5 in Mexico City, and over XHAJ-TV, Channel 6, a repeater station in Las Lajas, Veracruz. Mexican law requires commercial broadcasters to donate 12.5 percent of their broadcast time for government use, although this rule has rarely been enforced. Channel 5 has far exceeded this requirement, donating over 40 percent of its broadcast day to Telesecundaria. Despite Channel 5's generosity, the growth of the Telesecundaria system has been limited by the fact that it must rely solely on that channel. A project was initiated in 1969 to send taped lessons by plane to the northern state of Sonora, but this effort was discontinued because of administrative and scheduling difficulties.

Methodology of the Study

Most studies of educational technology projects, even when well executed, have been of limited value to scholars and decision-makers alike because they have examined only a single instructional

approach and because they have ignored costs. When the effectiveness of only one strategy is evaluated, it is very difficult to decide whether it is the most sensible one to pursue when there could well be other strategies that could do the job better. Likewise, when several instructional systems are compared on some criteria of effectiveness and one is found to be "better" than the others, it may still be very difficult to decide which should be adopted without some consideration of the relative costs. If a new and "better" system is projected to cost substantially more than the traditional one, it is necessary to consider how well the latter could perform if the cost differential were applied to improving it.

To execute a comparative analysis of this kind in Mexico, it was first necessary to define effectiveness in terms of the measurable outputs of the Telesecundaria and the traditional Ensenanza Directa* systems. Second, the inputs or resources of each system were identified. Third, the costs of those inputs were compared.

It was also useful to structure such an analysis on two levels. At a disaggregated level, the effects of a system on the individual student were considered. Outcomes such as achievement test scores and attitude measures were examined to compare the instructional effectiveness of the Telesecundaria and Ensenanza Directa systems. On a more aggregated level, the systems' enrollment capacities and their ability to produce graduates were examined. Such capacities were determined by analyzing the relative enrollment limitations put on

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* Ensenanza Directa refers to Mexico's regular academic secondary schools and not to technical or vocational schools which also enroll primary graduates.

each system by a fixed budget. It was also possible to estimate the number of teachers, classrooms, and other resources that could be provided. These estimates were translated into the maximum student enrollment possible within a particular system and budget and, given additional information on drop-out, repetition, and promotion rates, the number of graduates each system would be capable of producing over time.*

Input Characteristics of the Telesecundaria (TS) and Ensenanza Directa (ED) Systems

To understand the similarities and differences between the TS and ED systems, four categories of system inputs were examined: school and community characteristics, student characteristics, teacher characteristics, and costs.

Random samples of 9th grade classes were selected from each instructional system. The classes were chosen from four geographic areas: the Federal District of Mexico, and the states of Mexico, Hidalgo, and Morelos. Table II presents the student samples according to state and instructional system. In all, 58 9th grade TS classes containing 1,236 students were included in the sample along with 23 9th grade classes from the ED totalling 1,101 students. The sampling strategy was intended to provide a minimum of 1,000 students from

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* The model by which this analysis was accomplished, as well as the general methodology discussed here, is developed more fully in Dean Jamison and Steven J. Klees, The Cost of Instructional Radio and Television for Developing Countries, Institute for Communication Research, Stanford University, 1973.

each system and because ED classes are customarily much larger than those in the TS, fewer of them were needed to obtain the desired number of subjects.*

Table II

Student Samples by Area and Instructional System

	Distrito Federal		Valle de Mexico		Hidalgo		Morelos	
	TS	ED	TS	ED	TS	ED	TS	ED
No. of Classes	15	10	15	4	15	4	13	5
No. of Students	384	462	313	208	252	183	287	248
Average Class Size	26	46	21	52	17	45	22	49

Totals	Telesecundaria	Enseñanza Directa
	58 classes	23 classes
	1236 students	1101 students
	21 average class size	47 average class size

School and Community Characteristics

Included in both the teacher and student questionnaires that were administered in the sample classes were a number of questions concerning the schools and communities in which the two systems were

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* The four sampled states were chosen from among the eight in which TS exists. This was done after an analysis of test scores indicated that these four adequately represented the range of achievement in all TS classes. The ED sample, although random, is not representative of all ED schools throughout Mexico. However, since ED and TS classes were sampled randomly from the same states, comparisons within the four state region are valid.

operating. It was known that the TS had grown up largely in response to the demand for secondary education in Mexico's rural areas where regular schools were not available, and that certain qualitative differences were bound to exist between the two school systems as well as the communities in which they operated. The surveys were designed to verify and, where possible, quantify such differences. The results of this analysis are summarized below.

- - Although the TS and ED systems overlapped in many areas, teleaulas were generally located in poorer and more rural communities.

- - Teleaulas tended to be small and more flexibly organized institutions rarely serving more than 75 students in three grades; ED schools were large formal institutions customarily serving more than 500 pupils.

- - Teleaulas did not possess as many facilities or ancillary learning aids as did the ED schools.

Student Characteristics

Survey questionnaires were administered to students in the sample classes to determine what socioeconomic characteristics were common to both TS and ED students, and which ones were found in one group more than the other. A number of important differences between the sample student populations are summarized below:

- - Boys outnumbered girls in both systems, but the ratio of boys to girls was substantially higher in the TS classes.

- - TS students were generally older than ED students.

- - Parents of TS students had less formal education than parents of ED students.

- - Fathers of ED students held better jobs than TS fathers, a fact related to their superior level of schooling.

- - Students from both systems came from homes where the mass media (newspapers, magazines, radio, television, and books) were available and were used extensively.

Teacher Characteristics and Behavior

Surveys and direct classroom observation* of the classroom teachers in the TS and ED illuminated some differences but many more similarities among the two groups:

- - There were more men than women in both teacher samples, and the proportion of men to women teachers was higher in the TS.

- - TS coordinators had less general education and professional training than their ED counterparts.

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* Judith A. Mayo, The Observation of Telesecundaria and Ensenanza Directa Teachers in Mexico, Institute for Communication Research, Stanford University, 1973.

- - Despite differences in general education, professional preparation, and years of teaching experience, there were few significant differences in the classroom teaching behavior of TS and ED teachers.

- - The blackboard was the only instructional aid used regularly by TS and ED teachers.

- - TS and ED teachers allowed their students little opportunity to participate actively in the classroom, and students' participation was limited almost entirely to individual work at their desks.

- - The teaching behavior of TS coordinators changed markedly according to the subject they were teaching.
  Classroom observation actually revealed more changes in teaching behavior between subjects than between instructional systems. In other words, when the teaching methods of individual TS coordinators were compared in math and Spanish, the differences between them were greater than the differences observed between single-subject teachers in the ED system.

Costs of the Telesecundaria and Ensenanza Directa

The costs analyzed in the study included not only government outlays, but also costs incurred by local communities, students' families, and other groups within the private sector.* Costs were

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* The opportunity costs of students were not considered. If they had been, they would have increased the cost differential advantage of the TS because job opportunities in rural areas are fewer and lower paying than those in urban areas.

analyzed on a component basis to illuminate how and why the two systems differ and on a per student basis because the great difference in size between the two systems made a comparison of total system costs of only passing interest.* Finally, because the burden of proof must be on a new system or new technology to prove its worth, the costs of the older ED system were estimated conservatively (i.e. they were somewhat understated). The assumptions upon which the cost estimates rest are presented in more detail in the appendix.

In almost every educational television project, technology has been an add-on cost, for it has supplemented rather than replaced the classroom teacher and other components of an already existing system. Mexico's TS could be viewed in such terms to the extent that television is added to the traditional secondary school system. However, what distinguishes the TS and makes it viable for Mexico is that its traditional components are much less expensive than comparable elements found in the ED.

Table III reveals that the cost per student in 1972 was less for TS than for ED along the four principle traditional component categories - administration, classroom teachers, facilities, and student expenses. There were relatively fewer administrative personnel throughout the TS than in the ED and much less effort was put into the central administration of TS. Furthermore, as discussed in the previous section, the TS coordinators had less training than their counterparts in ED schools and thus received lower salaries. The

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* In 1972 the ED served 1,060,000 students at a total cost of ($211,664,000) while the TS enrolled approximately 29,000 students at a total cost of ($4,368,000).

teacher cost per student differential would have been even greater than those shown in Table III were it not for the fact that the average class size for the ED was twice that of the TS, thereby spreading ED's higher teacher cost over many more students.

The responsibility for providing classroom facilities in the TS system rests with the local parents' associations (patronatos), while in the ED system the state or federal government provides such facilities. Furthermore, as discussed previously, the typical telesala provides fewer school resources - libraries, laboratories, workshops, etc. These circumstances lowered the costs of the TS facility. Thus, traditional components of the TS system were substantially less costly than those of the ED - $125 per student vs. $200 per student, respectively. On the surface, it appeared that the traditional components of the TS system, taken alone, would also provide an inferior educational environment to that of the ED. However, TS added educational television to the traditional components.

The costs of television were divided into three categories - production, distribution, and reception. Production costs include outlays for studios, studio equipment and its maintenance, as well as the salaries of all administrative, technical, and television teaching personnel. Distribution costs are expenses incurred in the transmission of the televised lessons. They are relatively low in the TS system because Channel 5 donates all air time. The distribution costs in Table III reflect only the costs of the actual use of resources - the costs of power, personnel, and maintenance - incurred by Channel 5 in its broadcast of TS. Reception costs are the annualized

Table III

Annual Cost Per Student of ED and TS -- 1972*

Traditional Components	Ensenanza Directa	Telesecundaria
Administration	$ 50	$ 6
Classroom teachers	94	88
Facilities -- fully equipped classroom	28	11
Student costs -- books, uniforms, etc.	28	20
Sub-Total	$200	$125
ETV Components		
Production	$ 0	$ 1
Distribution	0	2
Reception	0	5
	0	26
Total Annual Cost per Student	$200	$151

* The assumption underlying these estimations is explained in the appendix. More detailed cost information may also be found there.

per student cost of one television receiver and its maintenance. All told, the ETV components added $25 per student to the cost of TS, yielding a cost per student hour of 7¢, assuming 400 hours of programming per grade per year in 1972, and a total cost per student of $151 compared to $200 for ED. In other words, TS was approximately 25 percent less expensive than ED on a per student basis.

System Performance of the Telesecundaria and Ensenanza Directa

What influence did the different combinations of resources used by the TS and ED systems have on the number of students receiving secondary schooling in Mexico and on the quality of that schooling? This section will consider the quantitative part of this question by analyzing the past and potential performance of the TS and ED in economic terms. The following section will evaluate and compare student learning in the two systems.

Measures commonly applied to evaluate the quantitative performance of an educational system include the number of graduates it can produce in a given period and its ability to satisfy educational demand. These measures are directly related to costs. Systems such as the TS and ED that exhibit different cost per student ratios are bound to produce different numbers of graduates and to satisfy different proportions of students wanting to enter school. By looking at how well TS and ED have performed on these criteria, it was possible to estimate how well, and at what cost, they could perform in the future.

Producing Graduates. A direct historical comparison of the numbers of graduates produced by TS and ED was not judged to be particularly important. ED functioned with a budget almost 50 times that of TS and produced many more graduates.* A better way of making such a comparison was to consider the efficiency with which each system produced a single graduate. In cost terms, efficiency was measured by the amount each system spent in a given year to obtain one graduate. The total cost of the TS system in 1972 was about $4,368,000. With the system producing approximately 6,600 graduates in that year, a cost per graduate of approximately $662 was computed. For ED, total costs in 1972 were approximately $216,608,000. The number of graduates in 1972 was about 238,300, resulting in a cost per graduate of $909. Therefore, in 1972 it cost 25 percent more to produce an ED graduate than a TS graduate.

Although cost per graduate computations reflected the overall performance of the two systems to date, they too were not entirely satisfying from a comparative viewpoint. They were based on the historical costs of the different operating environments of TS and ED. These environments strongly influenced costs. ED generally operated in more urban areas with larger class sizes and higher construction costs than TS. A more useful comparison of the ability to produce graduates resulted when the following question was posed: how many graduates could each system produce in the same environment

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* The budget refers to the total annual cost of each system. Since not all the component costs are paid by the Mexican government, the budget referred to here will be greater than the amount allocated to either system by the government.

over time with the same budget? Jamison (1973) described a methodology for answering such a question. The empirical information needed to do so was the total fixed cost and average variable cost per student, the growth rate over time of effective expenditures (defined as the growth rate of educational expenditures minus the growth rate of the costs of providing educational services),* and the drop-out, repetition and promotion rates for each system. The cost information was reported above, and the student flow-through rates were estimated from enrollment data and from a teachers' survey administered throughout the TS system in 1972.** Because the rate of growth of effective expenditures could not be estimated with certainty, it was necessary to compute the results for a range of values.

Table IV illustrates the result of applying Jamison and Klees' flow-through model to ED and TS. It was assumed that both systems began with a budget of $4,368,000 (this was the total cost of TS for 1972). The number of graduates for each system in succeeding years is shown as a function of alternative rates of growth of effective expenditures. For example, if the effective TS budget increased 6 percent annually, the system would be graduating 16,000 students in 1985.

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* It is necessary to look at the growth rate of effective expenditures in order to determine the increase in purchasing power of the educational budget. See Jamison (1972) for a more detailed explanation.

** The data indicated that both ED and TS had approximately the same repetition, drop-out and promotion rates. Repetition in both systems was nearly zero due to a system of make-up examinations. The drop-out rate between the seventh grade and the eighth grade is 18% and between the eighth grade and ninth grade was 12%. The rate of graduation from the ninth grade was 90%.

With a 6 percent effective budget increase each year, ED would only graduate 9,300 students in 1985. As might be expected given the difference in costs, TS always produces more graduates than ED given the same budget.*

(Insert Table IV here)

Satisfying Educational Demand. Similar results can be seen by examining a second dimension of system performance - the rate of demand satisfaction (RDS). This is defined as the percentage of entrants to secondary school in a given year relative to the number of primary school graduates from the previous year. The number of primary school graduates is an acceptable measure of the demand for secondary school services, while the entrants to secondary school constitute a reasonable measure of the degree to which that demand is satisfied.** This measure was of particular importance in the Mexican case because TS was instituted specifically to satisfy demand for secondary schooling in areas where ED was not available.

Considering only the eight-state region where TS operates, the primary system graduated 347,800 students in 1971, but only 229,200

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* This is true because the flow-through rates are the same for both systems. If TS had a higher drop-out rate than ED, it would be possible for TS to graduate fewer students than ED even with lower system costs.

** The rate of demand satisfaction as defined above was admittedly a very rough measure of the underlying concept that one would like to consider. Not all primary school graduates desire secondary schooling, nor do all secondary school entrants come from the ranks of the past year's primary school graduates. However, given existing knowledge and data limitations, the RDS measure was the best available.

Table IV

Number of Graduates of Telesecundaria vs Enseñanza Directa*
(in thousands of students)

Year	Growth Rate of Effective Expenditures** 0%	3%	6%	9%	12%
			Telesecundaria		
1972	6.6	6.6	6.6	6.6	6.6
1974	8.1	8.1	8.1	8.1	8.1
1976	7.3	8.1	8.9	9.8	10.7
1978	7.1	8.6	10.1	11.9	13.8
1980	7.7	9.5	10.9	14.3	17.4
1985	7.4	11.0	16.0	22.7	31.8
			Ensenanza Directa (A)		
1972	4.2	4.2	4.2	4.2	4.2
1974	5.1	5.1	5.1	5.1	5.1
1976	4.6	5.0	5.5	5.9	6.4
1978	4.5	5.3	6.1	7.1	8.1
1980	4.8	5.8	7.0	8.4	10.1
1985	4.6	6.6	9.3	12.9	17.8

* It is assumed that ED began with the same budget in 1972 as TS and faced a per student cost of $240.

** The rate of growth of effective expenditures is defined as the rate of educational expenditures minus the rate of growth of costs of educational services.

entered the regular secondary system the following year, yielding an RDS of 65.9 percent. This meant that 34.1 percent of the previous year's primary school graduates were not accommodated by the ED system.

Table V examines the relative ability of TS and ED to help satisfy this unfulfilled demand for different rates of growth of effective expenditures. For example, in 1972 the RDS for TS was 3.6 percent whereas if ED had been in operation instead of TS (with the same budget as TS), its RDS would have been only 2.2 percent. Table V assumes that the growth rate of primary school graduates in the eight-state region served by TS is 8.0 percent annually (the average national growth rate for Mexican primary school graduates in the 1965-70 period). This implies that effective expenditures for either system must grow at a rate greater than 8 percent if the system is to make any progress in reducing the unfulfilled demand. Thus, given the same money, TS promises to do a better job of reducing the unfulfilled demand for secondary school than ED. However, TS could not make any significant dent in the unfulfilled demand problem without a substantial expansion of its budget.

In this section, TS has been depicted as a more efficient system for producing graduates than ED. Furthermore, if ED were to attempt to do the same job as TS, the system would produce fewer graduates and contribute less to satisfying unfulfilled demand. The implications of these results are quite strong. If TS had been given the same budget as ED in its eight-state region in 1972, TS theoretically could have produced 50 percent more graduates than did ED and

Table V

Rate of Demand Satisfaction of Telesecundaria vs Enseñanza Directa*
(percentages)

	Growth Rate of Effective Expenditures**				
	0%	3%	6%	9%	12%
Year	Telesecundaria				
1972	3.6	3.6	3.6	3.6	3.6
1974	2.8	3.1	3.4	3.7	4.1
1976	2.3	2.8	3.3	3.9	4.5
1978	2.1	2.7	3.3	4.0	4.9
1980	1.8	2.4	3.2	4.1	5.3
1985	1.2	1.9	2.9	4.4	6.5
	Ensenanza Directa (A)				
1972	2.2	2.2	2.2	2.2	2.2
1974	1.7	1.9	2.1	2.3	2.4
1976	1.5	1.7	2.0	2.3	2.6
1978	1.3	1.6	1.9	2.4	2.8
1980	1.1	1.4	1.9	2.4	3.0
1985	0.8	1.1	1.7	2.5	3.6

* It is assumed that ED began with the same budget in 1972 as TS and faced a per student cost of $240.

** The rate of growth of effective expenditures is defined as the rate of growth of educational expenditures minus the rate of growth of costs of educational services.

reduced the amount of unfulfilled demand to zero. However, before any final judgement may be drawn about the cost-effectiveness of the two systems, it is necessary to compare the achievement levels of their students.

Student Achievement in the Telesecundaria and Ensenanza Directa

Achievement tests for the study were developed in accord with Mexico's secondary school curriculum. Limitations of time and personnel forced the investigators to limit to three the number of subjects tested and to concentrate only on third year secondary students (9th graders). Mathematics and Spanish were selected because they are core subjects throughout Mexico's primary and secondary school curricula. Because science is a subject area that is emphasized in the secondary cycle, Chemistry was selected as the third course in which to measure student achievement. Fifty item (60 in the case of Spanish) multiple choice tests were constructed with the help of subject matter specialists from the Planning Division of the Mexican Secretariat of Public Education (SEP). The tests were administered to both TS and ED samples at the beginning and end of the second semester.

Results of the three achievement tests are presented in Table VI. Analyses of these results may be summarized as follows:

- - Whereas TS and ED students exhibited roughly equal test scores at the beginning of the semester, the TS students gained slightly more over the semester in Mathematics, Spanish and Chemistry.

The samples of TS and ED were stratified according to four geographic zones which included the Federal District of Mexico City

Table VI

Results of Before and After Achievement Testing for Telesecundaria and Ensenanza Directa

Telesecundaria (TS)

Subject Matter	Means	Std. Dev.	Gain Score	No. of Students*
Math 1 (Feb.)	20.24	4.84		1,151
Math 2 (June)	25.92	6.74	+5.68	
Spanish 1 (Feb.)	26.39	6.62		1,110
Spanish 2 (June)	31.50	8.44	+5.11	
Chemistry 1(Feb.)	18.06	4.25		1,132
Chemistry 2(June)	24.31	6.15	+6.25	

Ensenanza Directa (ED)

Subject Matter	Means	Std. Dev.	Gain Score	No. of Students*
Math 1 (Feb.)	20.15	5.02		836
Math 2 (June)	22.76	5.86	+2.61	
Spanish 1 (Feb.)	24.54	6.72		781
Spanish 2 (June)	27.19	6.84	+2.65	
Chemistry 1(Feb.)	18.49	5.02		713
Chemistry 2(June)	22.70	6.27	+4.21	

* Number of students are those who took both tests.

(DF), Valley of Mexico (part of the State of Mexico surrounding the Federal District), Hidalgo (the state bordering the State of Mexico to the north), and Morelos (the state to the south of DF). Such a stratification strategy was deemed necessary since large cultural and socio-economic differences are believed to exist between the capital and central urban area of the country and almost all other areas. When the achievement scores of the two groups were analyzed by state (see Tables VII and VIII), the second major learning result emerged:

- - Change scores on achievement tests indicated a strong pattern of state differences, consistent across the three tests. There was more gain in learning in the more urban area of DF and the Valley of Mexico, less in the more rural areas of Hidalgo and Morelos.

The above pattern was found without exception in the TS results, and although not perfectly replicated in the ED results, it was generally found there as well. How does one explain this strong pattern in the achievement data? What is it about the different states that would cause such differences in learning? Would these differences also show up in other output variables in the same order? The answers to these questions were sought by looking at the relationship of other variables to achievement.

Ability Testing. The need for some measure of general ability skills in addition to measures of achievement was important for several reasons. First, general skills in reasoning, numerical, and logical thinking are good predictors of how students will do in future academic careers. These skills are also useful indicators of general intellectual capacity and of the opportunity the child has had to develop such capacity at

Table VII

Results of Before and After Achievement Testing for Telesecundaria by State

Area	No.Students	Mathematics Mean(Feb.)	Mean(June)	Gain
Federal District	353	20.28	28.84	+8.56
Valley of Mexico	300	21.46	26.85	+5.39
Hidalgo	226	18.89	23.94	+5.05
Morelos	272	19.96	22.73	+2.77

		Spanish Mean(Feb.)	Mean(June)	Gain
Federal District	336	26.06	33.22	+7.16
Valley of Mexico	293	29.03	35.03	+6.00
Hidalgo	210	25.04	29.09	+3.60
Morelos	271	24.73	27.41	+2.68

		Chemistry Mean(Feb.)	Mean(June)	Gain
Federal District	345	18.28	25.52	+7.24
Valley of Mexico	200	18.92	26.00	+7.08
Hidalgo	217	17.19	22.95	+5.76
Morelos	271	17.53	22.00	+4.47

Table VIII

Results of Before and After Achievement Testing for Ensenanza Directa by State

Area	No. Students	Mathematics Mean(Feb.)	Mean(June)	Gain
Federal District	350	20.78	23.80	+3.02
Valley of Mexico	138	19.38	22.95	+3.12
Hidalgo	144	20.04	22.51	+2.47
Morelos	199	19.35	20.99	+1.64
		Spanish		
		Mean(Feb.)	Mean(June)	Gain
Federal District	340	25.37	28.14	+2.77
Valley of Mexico	115	27.10	28.84	+1.74
Hidalgo	134	21.10	24.28	+3.18
Morelos	192	23.94	26.57	+2.63
		Chemistry		
		Mean(Feb.)	Mean(June)	Gain
Federal District	248	18.41	22.77	+4.36
Valley of Mexico	159	17.08	21.44	+4.36
Hidalgo	107	21.35	27.96	+6.61
Morelos	199	18.16	20.79	+2.63

home and in school. The reason for the inclusion of such tests in this study, however, was not to predict how students would do in future studies but rather to serve as controls for comparisons between TS and ED students.

The logic of the need for this kind of control was articulated before the evaluation was carried out. By its nature, TS serves a student group that is disadvantaged. Consequently, it was assumed that TS students had had fewer opportunities to develop general ability skills (regardless of innate capacity) and probably achieved less in school. In talking with a large number of Mexican educators in the year prior to the study, there was a general consensus that TS students could not be expected to do as well on achievement as regular secondary students.

In order to control for these expected differences and make some reasonable comparisons between students from the TS and ED samples, it was thought that general ability tests* could form a useful stratification or control variable. Stratification on general ability would alleviate the problem of having to compare better prepared ED students from privileged backgrounds with less prepared TS students from disadvantaged backgrounds.

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* The tests of general ability were administered by members of the National Center for Educational Guidance (Centro Nacional de Orientacion Educacion). The testing was carried out under strict administrative control of this group during March and April, 1972. The three tests formed part of a larger battery that the counseling service ordinarily administers to the students of Mexico's technical secondary schools. The three that were used for control purposes were the Otis Beta (Form A), a reasoning and verbal ability test, an analogies test for logical thinking, and a test of number skills, developed and used by the group over a period of years.

Unfortunately, two circumstances prevented the full use of the general ability test as a control for achievement. First, students from ED schools did not take the tests when they were administered to the TS schools. Secondly, the first administration of the achievement tests showed none of the large differences that were expected between the two groups, and so the ability tests were deemed less urgent for cross group comparisons.

A summary of general ability test results for the TS by state is found in the lower half of Table IX and in Table X. These findings suggest that:

- - General ability followed the same order by state as did achievement: the more urban the state, the higher the level of general ability. Also, general ability was strongly related to achievement and was the single largest factor accounting for the variance in achievement.

Thus, the general aptitudes TS students brought with them to secondary school strongly influenced how well they achieved. Also, students' abilities varied a great deal from one area to another.

Discussion of Learning Results

The learning performance of TS and ED students, even though somewhat higher for TS students, really indicated more or less equal achievement on the part of both groups. What made this finding so important was that despite a generally poorer, more rural and disadvantaged background, TS students did as well as their counterparts in the ED schools.

Table IX

Test Results from the Otis, Analogy and Number Tests for Telesecundaria Students, Total and by Geographical Areas

Total Scores for Entire Sample

No. Students	Test	Mean	St. Dev.
978	Otis	14.18	6.12
976	Analogy	6.02	3.12
976	Number	9.79	5.46

General Ability Scores by State

State	No. Students	Test	Mean	St. Deviation
D.F.	246	Otis	15.94	6.69
Valle de Mex.	286	Otis	14.23	5.60
Hidalgo	178	Otis	13.86	5.99
Morelos	268	Otis	12.71	5.77
D.F.	246	Analogy	7.12	2.98
Valle de Mex.	286	Analogy	6.61	3.03
Hidalgo	178	Analogy	5.33	2.94
Morelos	268	Analogy	4.86	2.97
D.F.	246	Number	11.42	6.02
Valle de Mex.	286	Number	9.96	5.09
Hidalgo	178	Number	10.36	5.49
Morelos	268	Number	7.75	4.63

Table X

Pearson Correlations of General Ability and Achievement Tests for Mathematics, Spanish and Chemistry for TS.

General Ability Tests	Mathematics Achievement Scores		
	Before	After	Change
Otis	.27[3]	.28[3]	.09[3]
Analogies	.29[3]	.35[3]	.15[3]
Number skill	.34[3]	.41[3]	.17[3]

	Spanish Achievement Scores		
	Before	After	Change
Otis	.32[3]	.30[3]	--
Analogies	.26[3]	.26[3]	--
Number skill	.25[3]	.27[3]	.08[2]

	Chemistry Achievement Scores		
	Before	After	Change
Otis	.24[3]	.21[3]	--
Analogies	.22[3]	.21[3]	--
Number skill	.28[3]	.29[3]	.09[2]

Note: Numbers above the correlations indicate the levels of significance: 1=$p < .05$; 2=$p < .01$; 3=$p < .001$.

On the basis of three achievement tests, it would be irresponsible to conclude that TS is a superior instructional system. In fact, many observers of the TS in and outside of Mexico have been highly critical of its quality. TS administrators admit that the telelessons are not as good as they might be, but they ask: are they any worse than the average classroom presentation of the regular secondary school teacher? No one can conclusively answer that question, but it might be quite revealing if one were to observe classroom teaching in both the TS and ED systems on a regular and unobtrusive basis. The limited teacher observation carried out as part of this study suggested that the teaching behaviors of the ED and TS teachers were actually quite similar.*

Another factor which may help explain the encouraging learning performance of TS students is motivation. If rural primary graduates do not get secondary education from television they will probably not get it at all. Thus, the motivation of individual students in TS schools may play an important part in their achievement. There is no direct evidence for this other than impressionistic evidence gathered from a number of visits to rural schools in the four state area. If motivation is a factor, it is but one consideration for decision-makers to keep in mind as they seek to expand educational opportunities throughout Mexico. There is an accompanying caution to be made, however. Even if disadvantaged rural students can learn from a system of televised instruction, schooling itself may foster unrealistic aspirations. If school engenders the desire for more schooling and for jobs that are not available in the Mexican countryside, the high level of motivation

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* Judith A. Mayo, op.cit.

may be replaced by a frustration and/or an accelerating exodus of ambitious young people from the rural areas.

The Future of Telesecundaria

The TS system, using television in combination with more familiar educational resources such as classroom teachers and textbooks, has enabled Mexico to extend secondary schooling to rural communities whose size and isolation have heretofore prevented the construction of regular schools. At the same time, the TS has provided a second chance for many urban students who, for a variety of scholastic and economic reasons, have not been able to gain admission to regular secondary schools.

On the basis of available evidence, the TS appears to be accomplishing its basic pedagogical objectives. Test results in three subject areas indicated that students taught by television were learning with the same degree of success as their counterparts in the regular secondary schools. While students in the regular schools had a head start - they came from more privileged backgrounds and were better prepared - the achievement levels of students in the two systems were quite similar.

When one considers the lower cost of teachers and facilities in the TS (approximately 25 percent lower than regular secondary schooling on a per student basis), the appeal of the TS to cost-conscious planners is evident. Cost projections revealed that at higher enrollment levels the TS system would offer even greater savings over the regular

secondary school system; the differential in favor of the TS rises with each increase in enrollment. Indeed, on virtually all dimensions of cost that were measured as part of the current evaluation, the TS was found to be more economical than Mexico's traditional secondary school system.

Two of the most important factors responsible for keeping TS's costs below those of the regular secondary schools were the local initiative and voluntary effort found in the rural communities themselves. To provide schooling for their children, rural parents have formed associations to furnish and maintain practically all of the necessary TS classrooms. Money to purchase the television sets and other materials was raised through charitable efforts or through the organization of community fairs. Such activities encouraged local participation and built community spirit which, in turn, nourished the television schools and the community as a whole. The qualities of individual sacrifice and community self-reliance that are so necessary to the operation of the TS system may be. in themselves, the most lasting rewards of the system.

APPENDIX

Notes on Cost Estimates and Comparisons

SECTION A: Basis for Cost Calculations for Ensenanza Directa 1972

Cost Components	Basis
Administration	The administration costs per student of the ED system are assumed to be 54% of teacher costs as was the case for the last five year period on which such data is available, 1961-1965. The source is the report by the Mexican Comision Nacional de Planeamiento Integral de la Educacio (CNPIE).
Classroom Teachers	A full-time teacher equivalent (there are few full-time teachers) is assumed to work 39 hours per week for an average monthly salary of $390. With an average class size of 50, an annual teacher cost per student of $94 can be computed.
Facilities	An untitled Federal District report that estimates public expenditures for September 1968 to August 1969 showed a cost per equipped secondary school classroom of $18,880. This was annualized over a 20 year period and spread over an average class size and average classroom utilization rate of 1.5 (i.e., half the schools were on double session).

Cost Components	Basis
Student costs	The costs of books and notebooks were estimated at $24 per year, and the cost per uniform at $4 per year.

SECTION B: Basis for Cost Calculations for Telesecundaria 1972

Traditional Components	Basis
Administration	The total administrative cost of TS for 1972 was $168,000. Administrative costs are assumed to vary with the number of students in the system. Given there were approximately 29,000 students in the system in 1972, an annual administrative cost per student of $5.60 c[illegible]
Classroom Teachers*	Assuming a full-time teache[illegible]s $168 per month and has an average class size of 23, an annual teacher cost per student of $88 can be computed.
Facilities	Survey data showed an average construction cost of $4,160 per classroom and annual rental of $192 per classroom per year, assuming a 20 year life and that half the classrooms are constructed and half are rented (actually this overstates the

* In 1972 there was a raise of primary school teacher salaries of $16 per month which caused TS unit costs to increase by about 10 percent. However, secondary school teacher salaries are expected to be raised soon and this action will maintain the cost per student advantage of TS.

Traditional Components (contd.)	Basis
Facilities (contd.)	cost because less than half are constructed and many are donated). Average class size is again 23 students from which an annualized cost of $11.92 per student per year can be computed. Because of the aforementioned overstatement, it is assumed that this figure includes maintenance.
Student Costs	The average cost of books is less for the TS system ($16) than for ED. Adding a $4 cost per uniform per year yields an estimate of $20 per student per year for this category.

ETV Component Production	Basis
Personnel and Administration	The cost for 1972 as estimated by DGEAD personnel was $220,000.
Teleteachers	Teachers are paid on an hourly basis at $10.40 per week-hour per month and receive seven hours teaching credit for each program they teach. Given that about 100 programs are produced each week over a 38 week school year and that DGEAD adds about $16,000 annually in bonus pay, a yearly cost of $104,000 can be calculated for the teleteacher.

ETV Component Production (contd.)	Basis
Studios	There are four studios built at a cost of about $32,000 per studio, and their cost is annualized over a 20 year life to arrive at an estimate of $15,200 per year.
Studio Equipment	The total cost of existing studio equipment was computed at $304,000 and was annualized over a 10 year life to arrive at a yearly cost of $49,600.
Video Tapes	The present stock of about 1,500 hour-length tapes, costing $240 per tape, was allocated over a 12-1/2 year period, which assumes a utilization rate of about 120 tapes per year (i.e. 10 percent of programming is taped).
Maintenance	This cost was estimated in 1972 at $120,000.
Transmission Operations	Estimates are based on the operation costs of a system of the same size and power as Channel 5. The cost of transmission equipment is estimated at $2,112,000. Forty percent of operations costs are allocated to TS, with operations costs estimated as foilows: five percent of facility cost per year for maintenance = $105,600 for power and utilities. To this 40 percent allocation is added the cost of two full-time personnel at $4,000, yielding a total annual cost of $52,000.

ETV Component Production (contd.)	Basis
Reception	
Receiver	The price of the television set is assumed to be $280 (somewhat high so that it includes the cost of the antenna) annualized over a five year life. A yearly maintenance cost of 10 percent of purchase price is added. With an average class size of 23, an annual receiver cost per student of $4.80 is obtained.